Anterior segment axial motion correction using the cornea surface

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PURPOSE

Imaging of the anterior segment using optical coherence tomography (OCT) is useful for surgical planning, post-operative monitoring, and disease diagnosis. However, axial motion during OCT acquisition degrades image scan quality leading to ambiguous clinical interpretation and even erroneous diagnosis. Correcting axial motion during anterior chamber imaging is challenging due to low contrast in the cornea compared to the iris and changing pupil sizes during scan acquisition. Therefore, we developed an axial motion correction algorithm using deep learning (DL) segmentation of the cornea surface as a reference to improve image quality.

METHODS

- Dataset: 60 OCT cube scans (6 mm x 6 mm x 6 mm, PLEX® Elite 9000, ZEISS, Dublin, CA) from 13 healthy subjects

- Manual rating of axial motion correction quality for each segmented surface:

    3: acceptable || **2**: partially acceptable || **1**: failed

- Algorithm Steps:

    1. DL-based model segments the cornea surface of the reference scans and B-scans (Presented in ARVO Poster 1120-C0214: April 23rd 2023)

    2. Polynomial model fit using RANSAC models the cornea surface of the reference segmentation

    3. Axial motion compensation values for each B-scan in the fast direction are calculated as the difference between the model fit and the segmentation of the corresponding cross-section of the volume segmentation points

CONCLUSIONS

The developed algorithm for anterior segment axial motion correction using corneal surface segmentation shows that improved axial motion correction results in more acceptable image quality with 93% at least partially acceptable. Implementation of the algorithm will assist clinical assessment of the entire anterior chamber.

RESULTS

| Reference scan | **Slow B-scan Before correction** | **Slow B-scan After correction** |
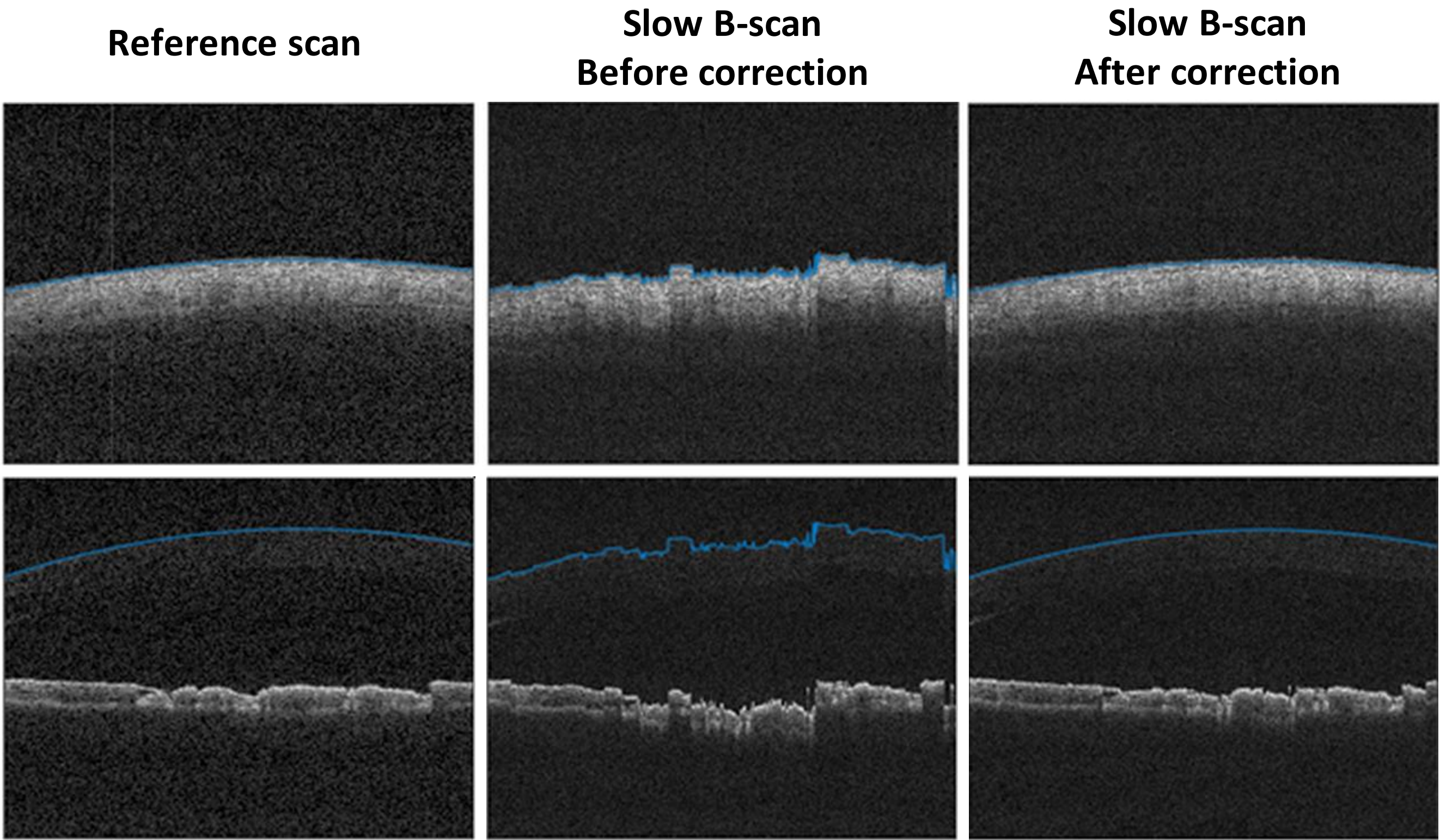
Two reference scans at 20% (top row) and 80% (bottom row) of the fast scan direction and corresponding slow B-scans sampled from the cube before and after correction with quality grade 3.

MANUAL GRADING OF SCAN CORRECTION

GRADES (1) (2) (3)

77
16
7

0   20   40   60   80   100
% OF IMAGES WITH EACH MANUAL GRADE LEVEL